

Inclusive Charm Production in Two Photon Collisions at LEP with the L3 Detector

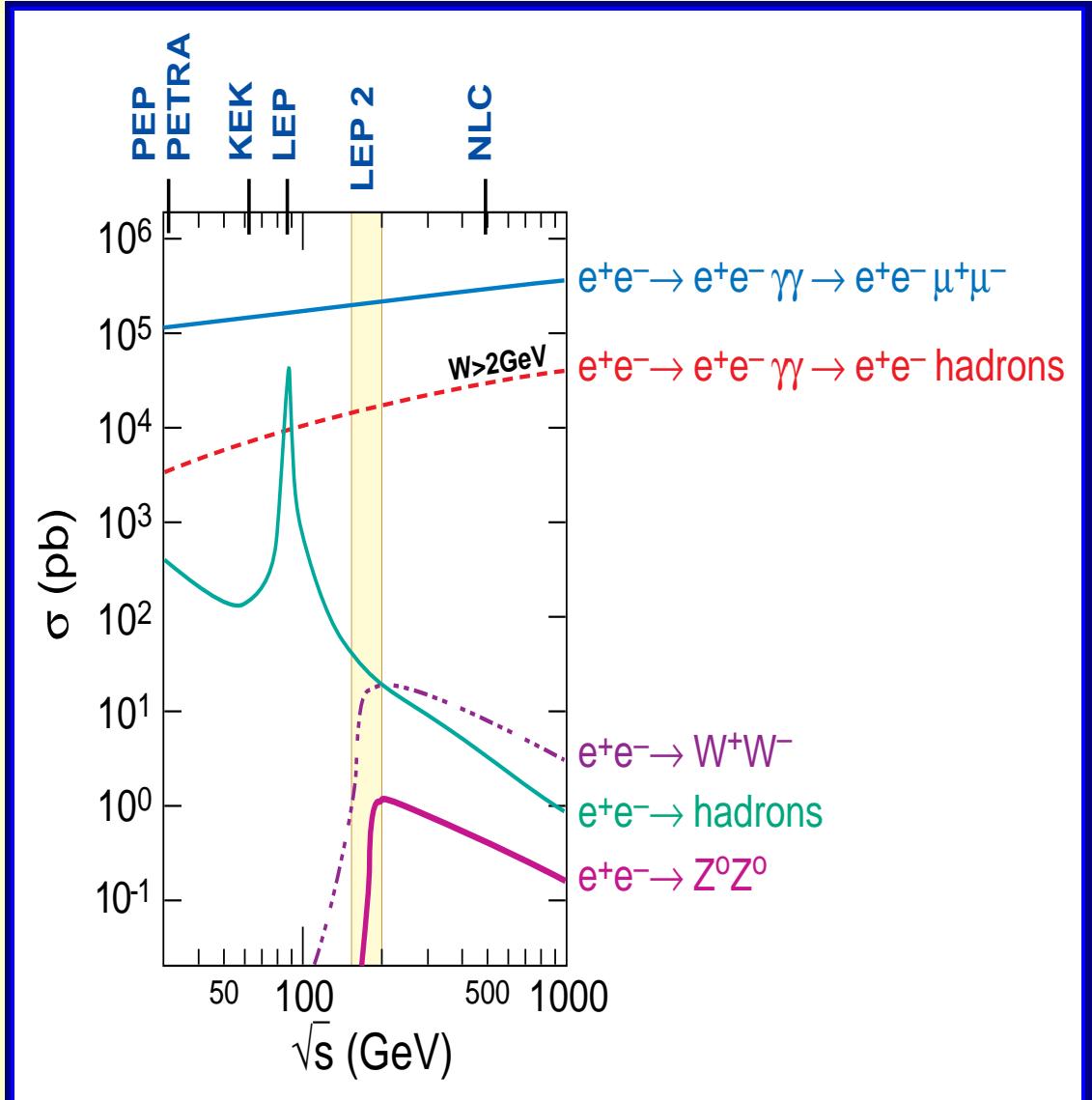
Alan L. Stone

Louisiana State University

24 March 1999
APS Centennial, Atlanta

- Two Photon Introduction
- Motivation
- Analysis
- Results

Two Photons

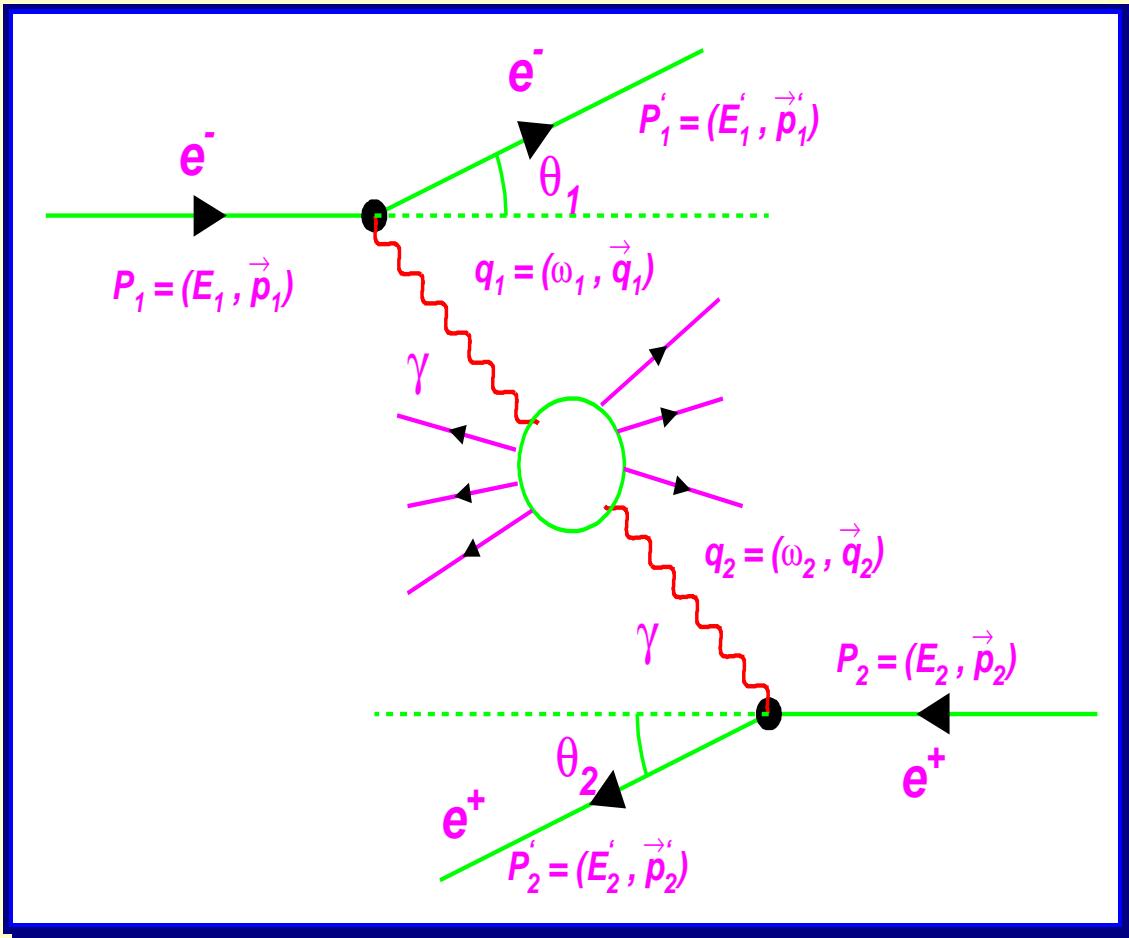


- Main contribution to hadron production at LEP

$e^+e^- \rightarrow e^+e^-\gamma\gamma \rightarrow e^+e^- \text{hadrons}$

- Bkgd to other processes.

Two Photons

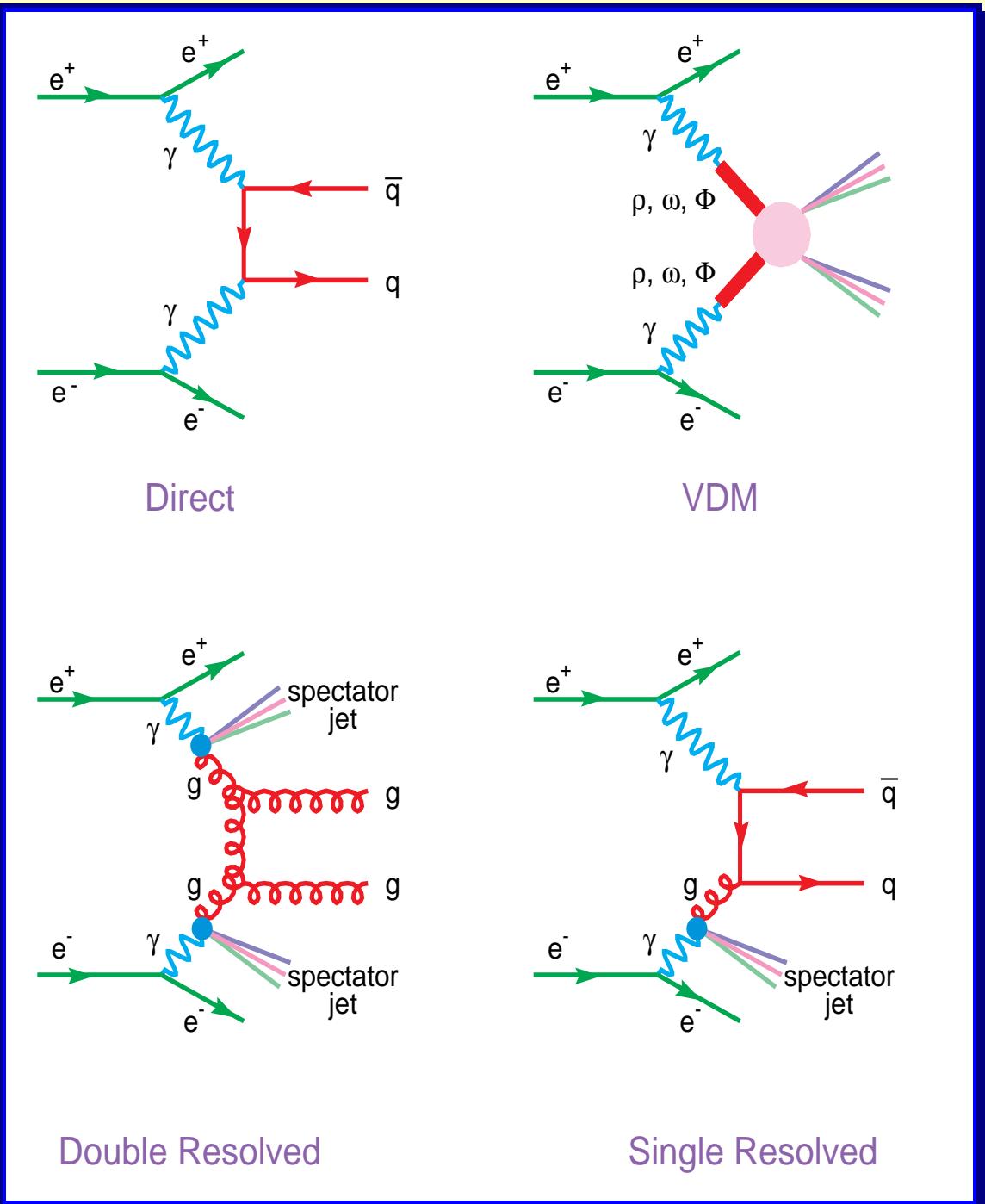


- $Q_i^2 = -q_i^2 = 2E_i E'_i (1 - \cos\theta_i)$
- $W_{\gamma\gamma}^2 = (\sum_h E_h)^2 - (\sum_h \vec{p})^2$

□ Photon Photon Scattering

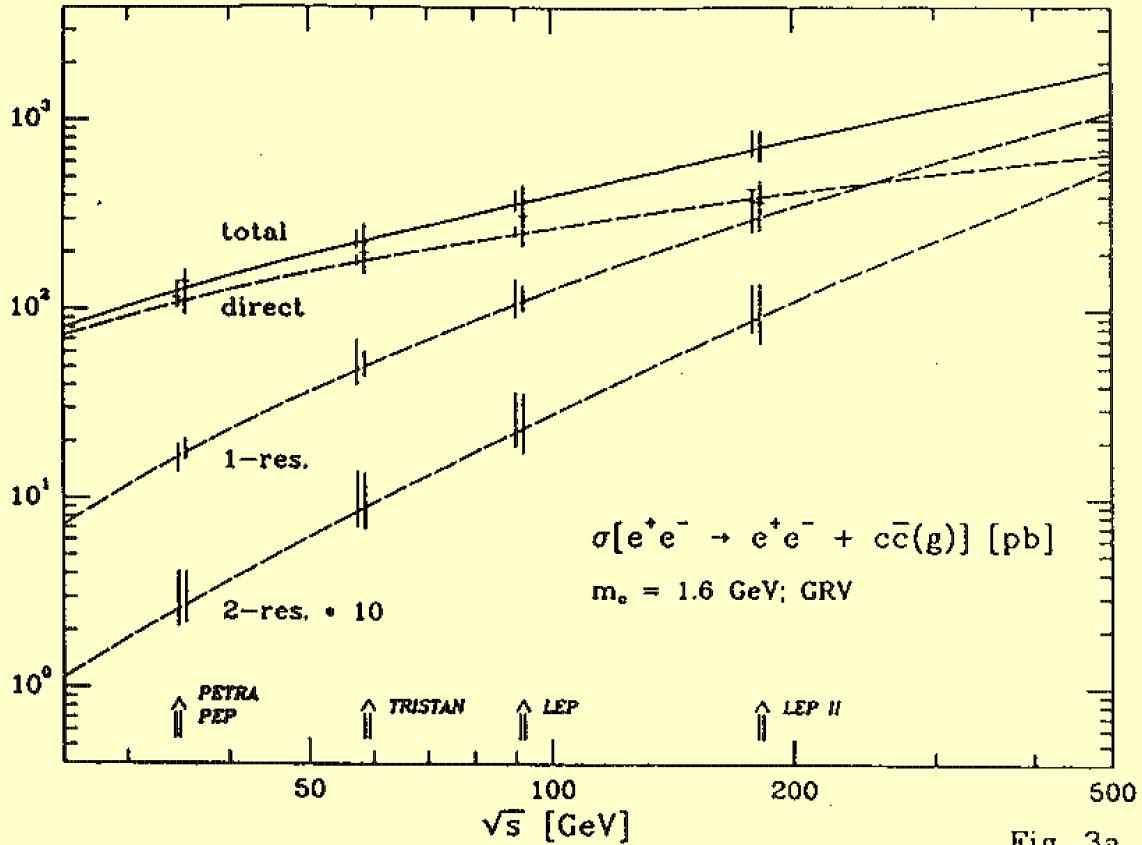
- Untagged Events ($Q_i^2 \approx 0$)
- Exclusive/Inclusive Hadronic States

Inclusive Hadronic Production



VDM Diagram is dominant at low Q^2

Motivation



Ref: M.Drees, M.Kramer, J.Zunft & P.M. Zerwas
 Physics Letters B 306 (1993) 371

- Test of QCD
- Gluon content of Photon (resolved...)
- Constrain Mass of Charm Quark
- First LEP2 measurement

$$\int \mathcal{L} dt = 165 \text{ pb}^{-1} \text{ at } \sqrt{s} = 91 - 183 \text{ GeV}$$

Hadron Selection

- $N_{tracks} \geq 5$
- $E_{Lumi}/E_{beam} < 0.4$
- $E_{total}/\sqrt{s} < 0.38$
- $W_{vis} > 3 \text{ GeV}$

\sqrt{s} (GeV)	L (pb^{-1})	Events	Bkgd (%)
183	52	116760	0.2
161-172	21	44444	0.2
130-140	12	21045	0.2
91	80	93204	2.4

MC: PYTHIA vers. 5.722

L EPA ($Q^2 < 1 \text{ GeV}$)

Background Sources

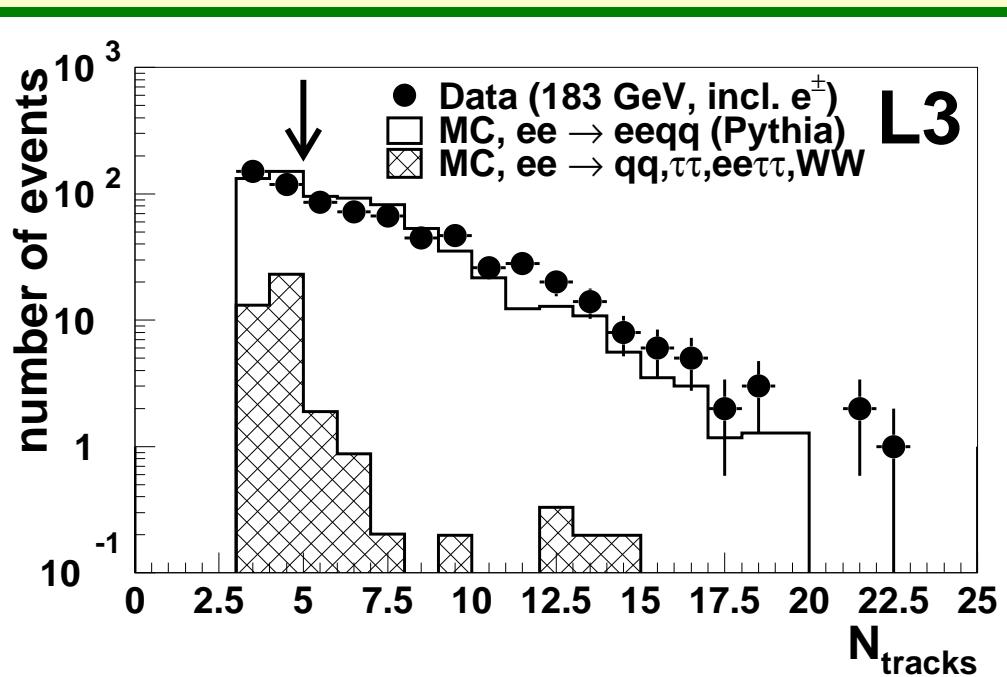
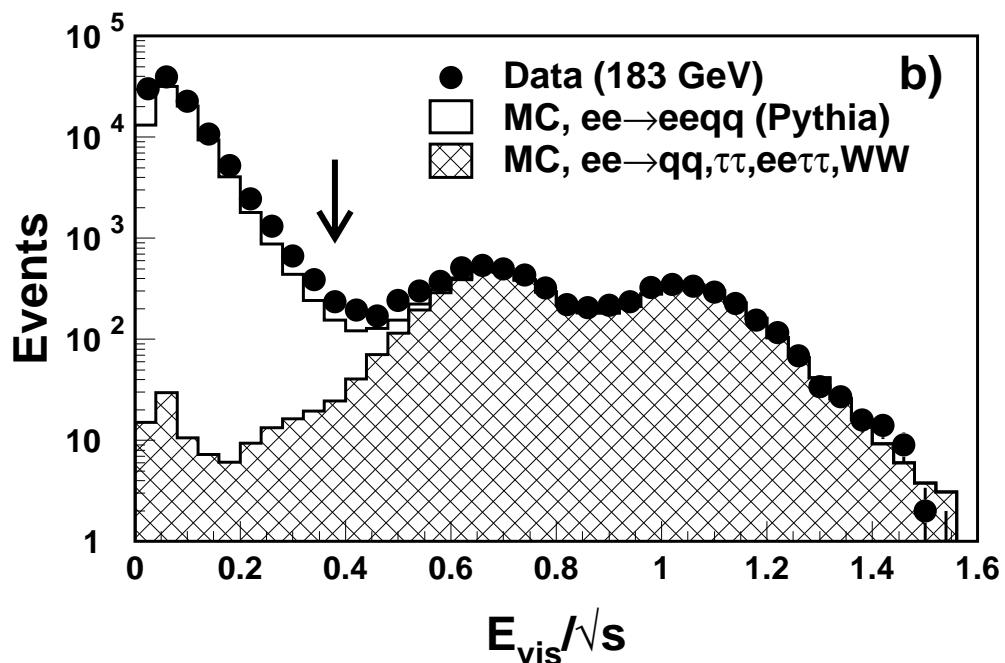
$e^+e^- \rightarrow q\bar{q}$ (PYTHIA)

$e^+e^- \rightarrow \tau^+\tau^-$ (KORALZ)

$e^+e^- \rightarrow W^+W^-$ (KORALW)

$e^+e^- \rightarrow e^+e^-\tau^+\tau^-$ (DIAG36)

Analysis



Lepton Selection

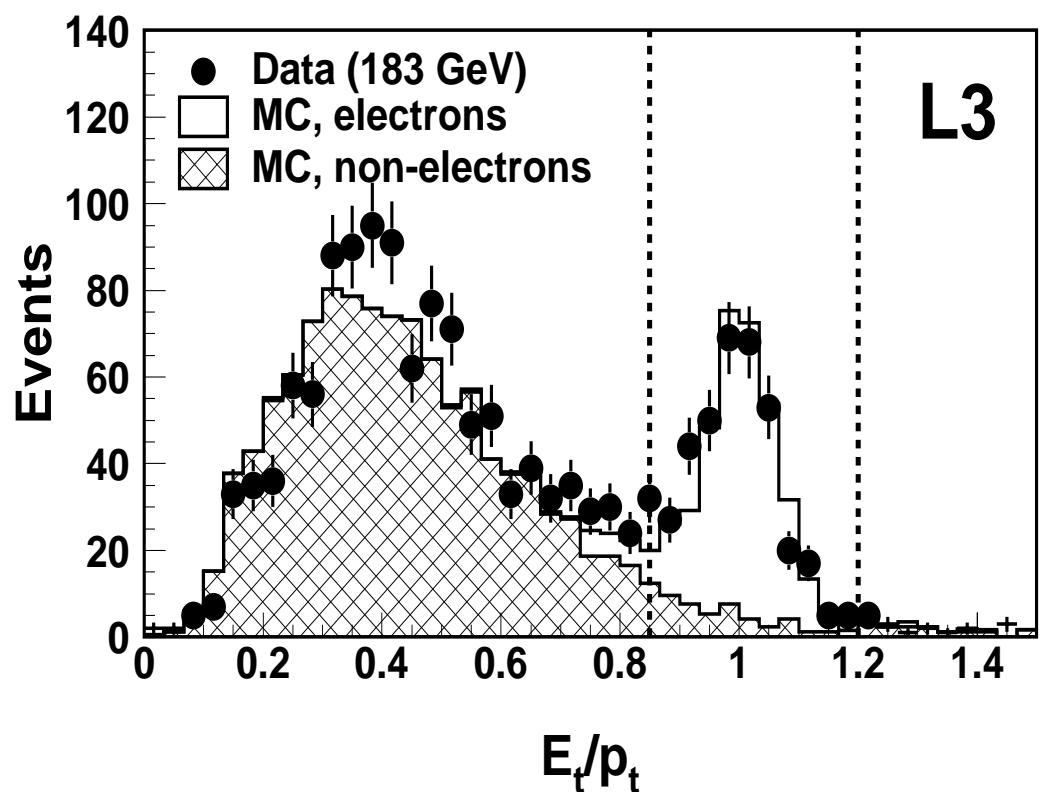
$c \rightarrow \text{lepton(s)}$

μ^\pm Selection

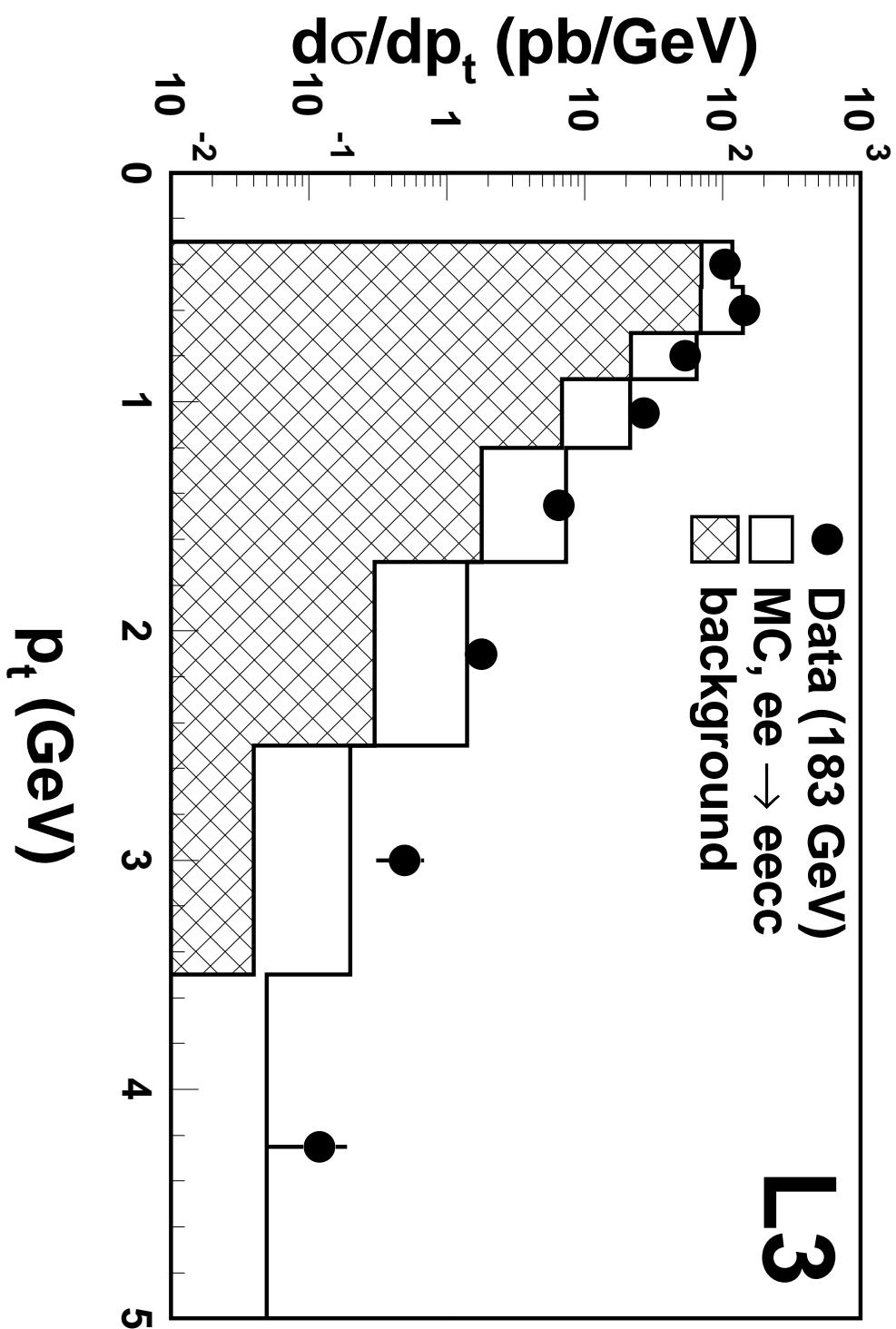
$|\cos \theta| < 0.90$
 $P_\mu > 2 \text{ GeV}/c$
 $P_\mu < 0.2E_{\text{beam}}$

e^\pm Selection

$|\cos \theta| < 0.90$
 $E_e > 0.6 \text{ GeV}$
 $\Delta\phi < 20 \text{ mrad}$
 $0.85 < E_T/p_T < 1.2$

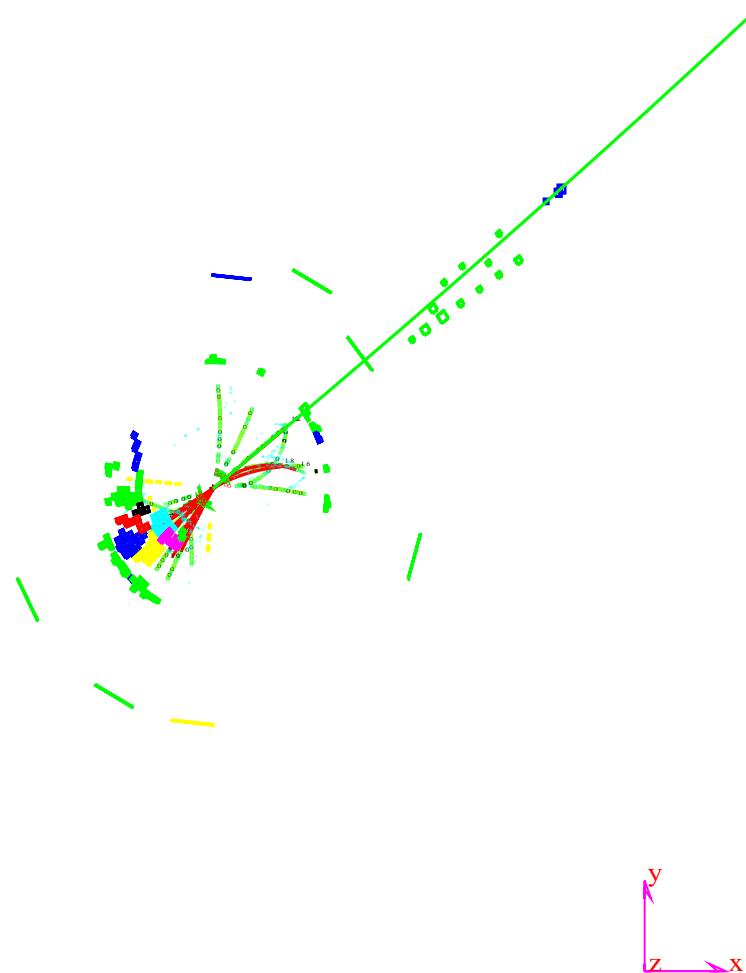


Results



Results

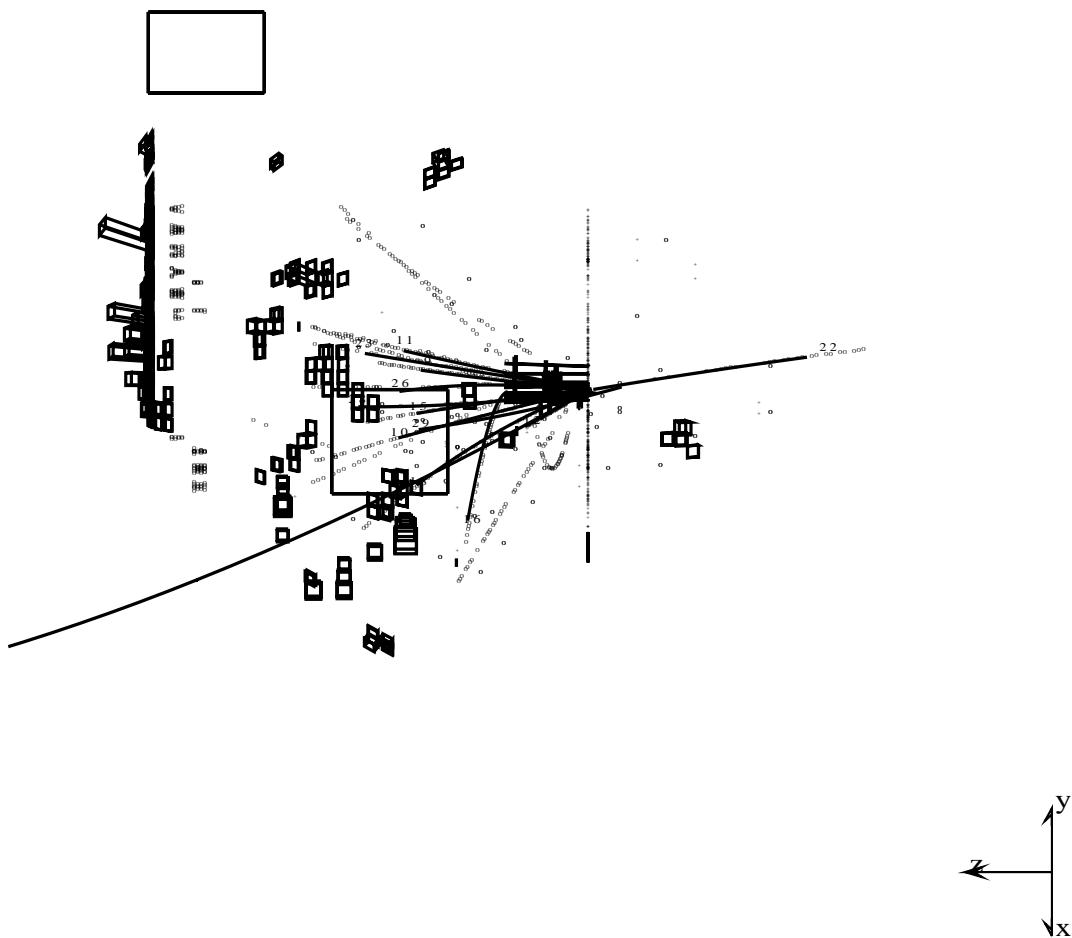
Run # 658001 Event # 3689 Total Energy : 36.91 GeV



Transverse Imbalance :	.1674	Longitudinal Imbalance :	.5708
Thrust :	.7686	Major :	.5903
Event DAQ Time :		960717 43936	

Results

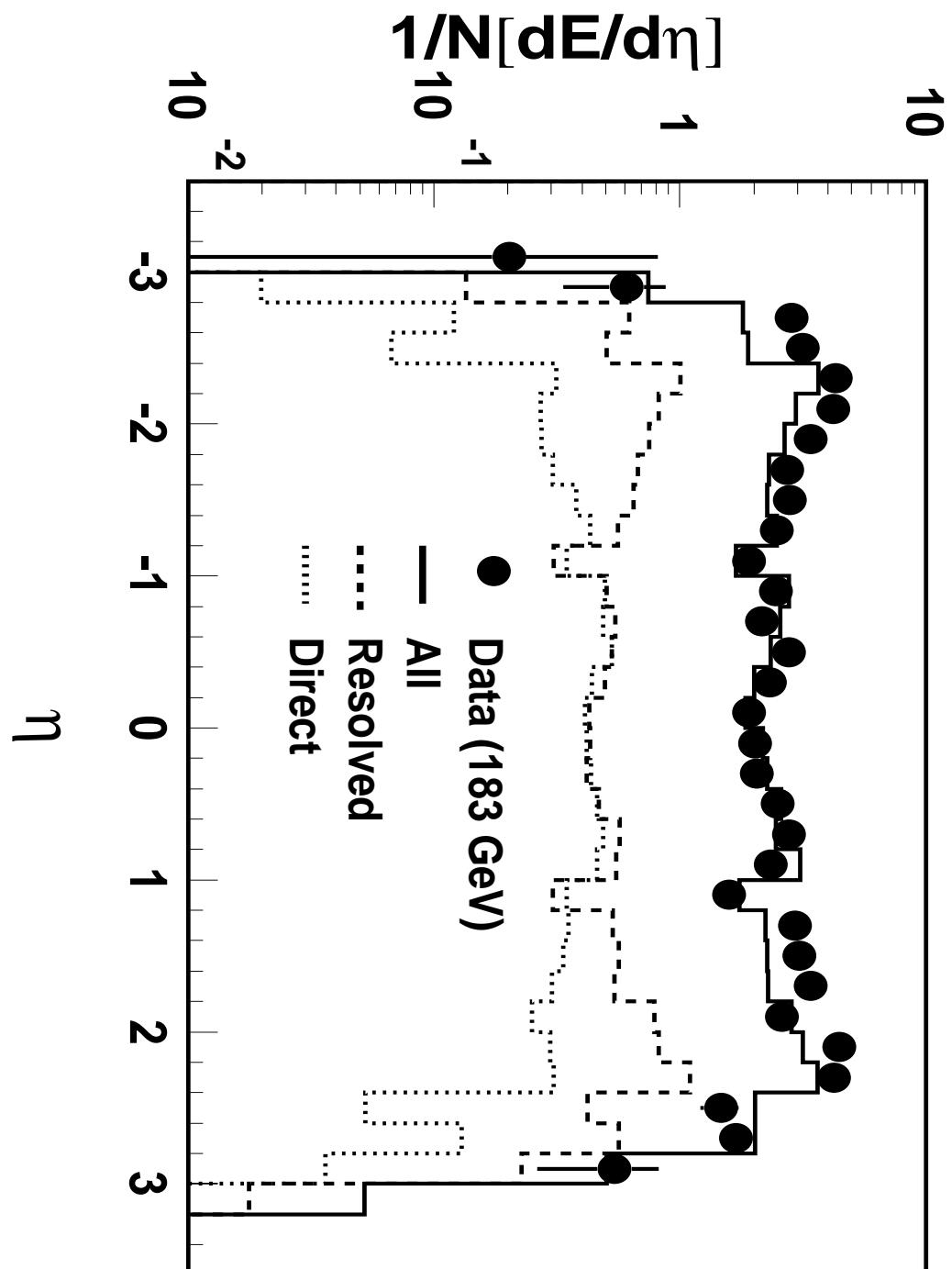
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Transverse Imbalance :	.1674	Longitudinal Imbalance :	.5708
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Results

12



Results

Cross section of Charm Production in $\gamma\gamma$ Collisions

$$\sigma = \frac{N_{sel}}{\mathcal{L}} \frac{P_{charm}}{\epsilon_{charm}}$$

◻ $e^+e^- \rightarrow e^+e^-c\bar{c}$ (**Electron Tag**)

$$\begin{aligned}\sigma_{183 \text{ GeV}} &= 1290 \pm 110 \text{ (stat)} \pm 120 \text{ (syst)} [\text{pb}] \\ \sigma_{161-172 \text{ GeV}} &= 1010 \pm 150 \text{ (stat)} \pm 110 \text{ (syst)} [\text{pb}] \\ \sigma_{130-140 \text{ GeV}} &= 1360 \pm 240 \text{ (stat)} \pm 180 \text{ (syst)} [\text{pb}] \\ \sigma_{91 \text{ GeV}} &= 440 \pm 60 \text{ (stat)} \pm 80 \text{ (syst)} [\text{pb}]\end{aligned}$$

◻ $e^+e^- \rightarrow e^+e^-c\bar{c}$ (**Muon Tag**)

$$\begin{aligned}\sigma_{183 \text{ GeV}} &= 1260 \pm 330 \text{ (stat)} \pm 250 \text{ (syst)} [\text{pb}] \\ \sigma_{161-172 \text{ GeV}} &= 580 \pm 360 \text{ (stat)} \pm 190 \text{ (syst)} [\text{pb}] \\ \sigma_{91 \text{ GeV}} &= 600 \pm 170 \text{ (stat)} \pm 160 \text{ (syst)} [\text{pb}]\end{aligned}$$

Results

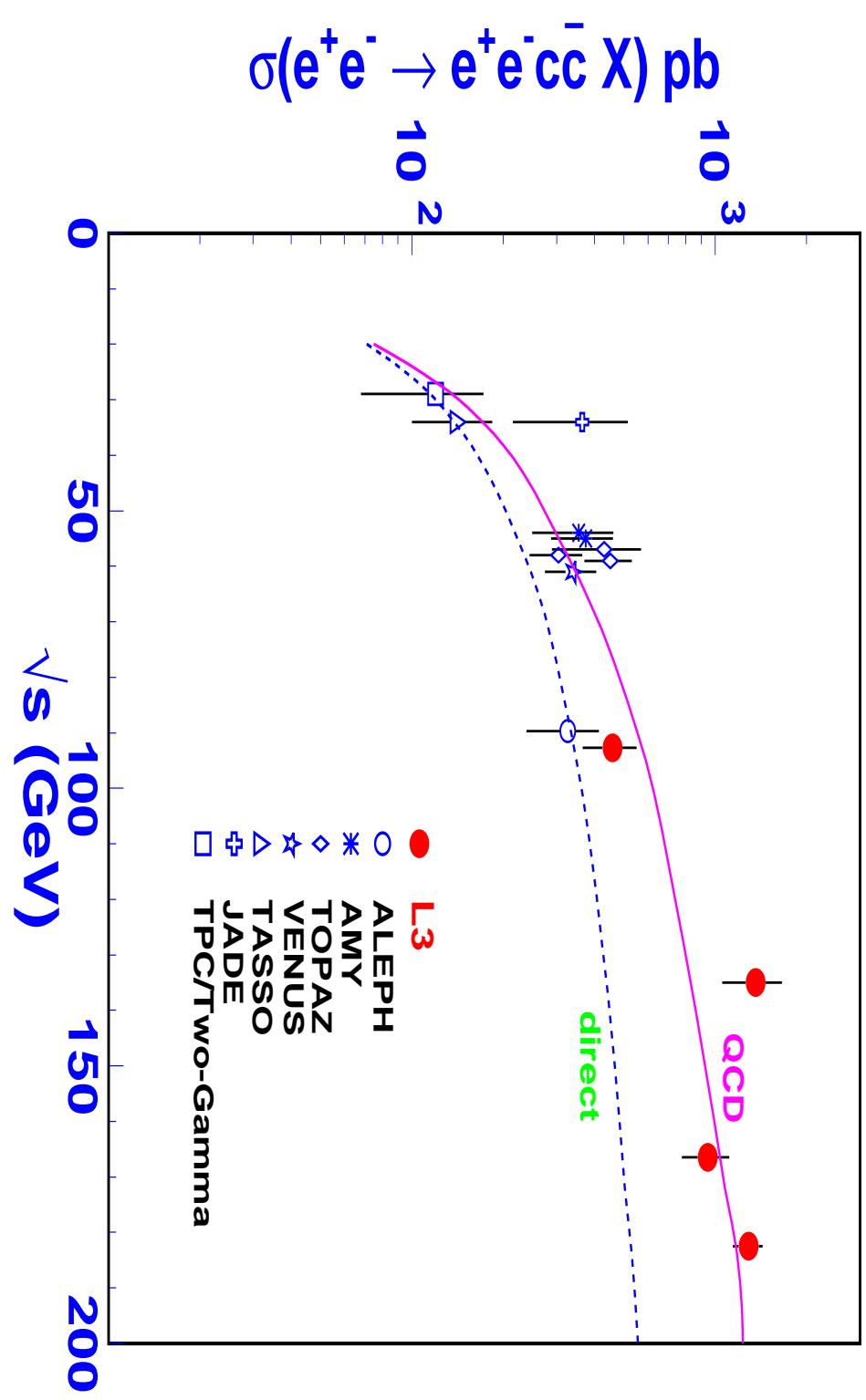
Cross section of Charm Production in $\gamma\gamma$ Collisions

$$\sigma = \frac{N_{sel}}{\mathcal{L}} \frac{P_{charm}}{\epsilon_{charm}}$$

■ $e^+e^- \rightarrow e^+e^- c\bar{c}X$ (**Combined Lepton**)

$$\begin{aligned}
 \sigma_{183 \text{ GeV}} &= 1290 \pm 100 \text{ (stat)} \pm 110 \text{ (syst)} [\text{pb}] \\
 \sigma_{161-172 \text{ GeV}} &= 940 \pm 140 \text{ (stat)} \pm 100 \text{ (syst)} [\text{pb}] \\
 \sigma_{130-140 \text{ GeV}} &= 1360 \pm 240 \text{ (stat)} \pm 180 \text{ (syst)} [\text{pb}] \\
 \sigma_{91 \text{ GeV}} &= 460 \pm 60 \text{ (stat)} \pm 70 \text{ (syst)} [\text{pb}]
 \end{aligned}$$

Results

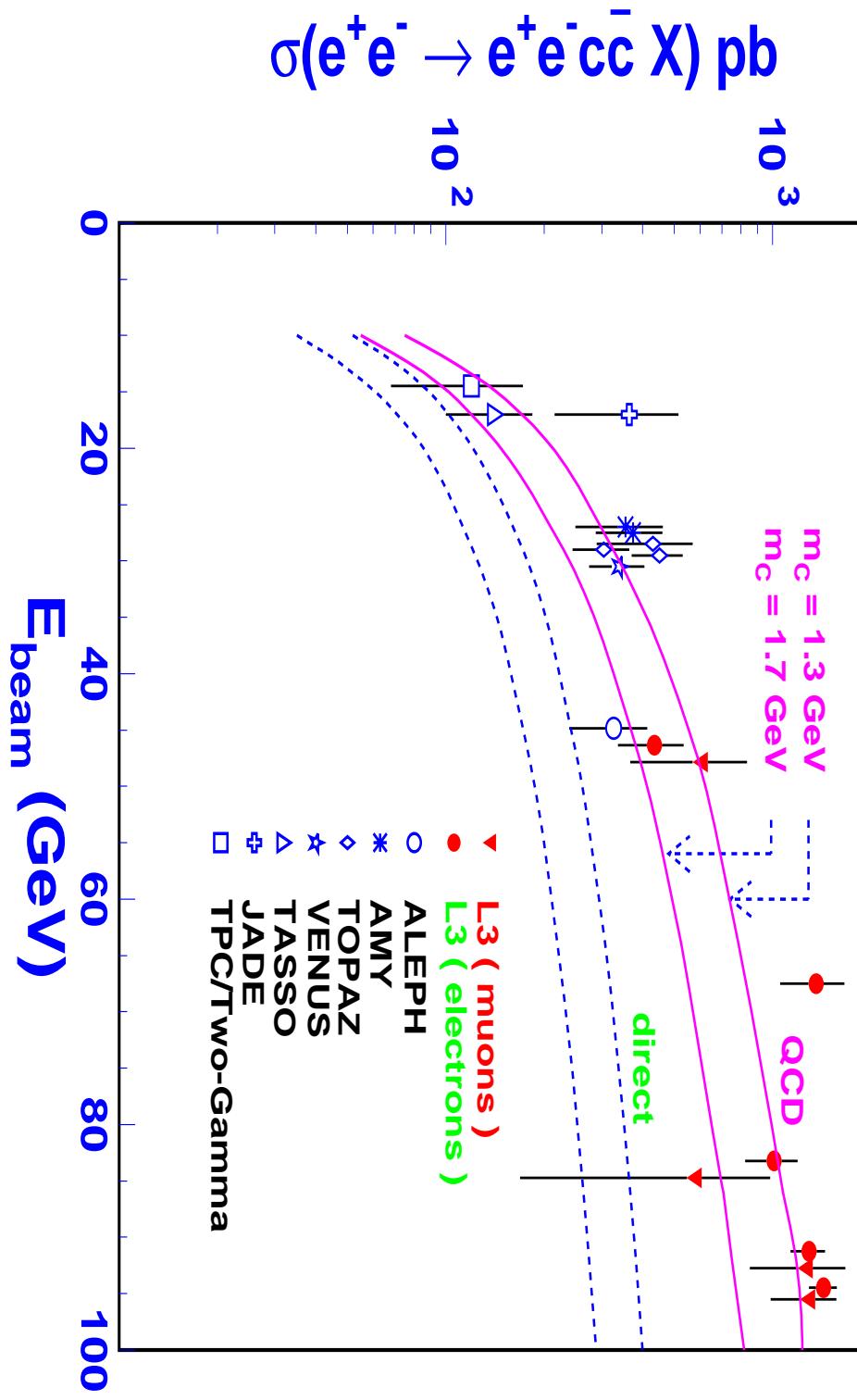


CERN-EP/98-185

Conclusion

- ❑ Cross Sections of inclusive charm production in $\gamma\gamma$ collisions have been measured with L3 detector at LEP1, LEP1.5 and LEP2 energies using **lepton tag**.
- ❑ Results are **in agreement with QCD predictions**.
There is a need for **resolved processes**.
- ❑ Higher energy Charm Tag analyses are **in progress**.

Preliminary Results



Preliminary Results

